

peopleand oceans

managing marine areas for human well-being



SCIENCETOACTION

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This publication is funded by

Gordon and Betty Moore Foundation
National Fish and Wildlife Foundation
National Oceanic and Atmospheric Administration

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Printed on 100% recycled paper (50% post-consumer)

Table of contents

- 3 Managing oceans for human well-being
- 4 People depend on oceans
- 6 Sustainable human cultures need sustainable environments
- 8 Governance and enforcement are critical to managing oceans
- 10 MMAs improve human well-being
- 12 MMAs are influenced by socioeconomic and governance conditions
- 14 MMAs secure economic values of oceans
- 16 Buyouts, conservation agreements, and alternative livelihoods provide economic incentives
- 18 Recommendations
- 19 References

Preferred citation:

Samonte G, Karrer L, Orbach M. 2010. *People and Oceans*. Science and Knowledge Division, Conservation International, Arlington, Virginia, USA.

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Managing oceans for human well-being

Although much research has been done on the ecological benefits and challenges of marine resource management, comparatively little insight has been gained into the benefits and challenges of the human well-being aspects. This document addresses this gap by building on existing knowledge and synthesizing over 20 social science studies conducted over the past five years in 19 countries, involving over 35 scientists, and drawing on experiences in 52 marine managed areas (MMAs) worldwide (see References and www.science2action.org).^{1,2}

This booklet demonstrates an awakening within the conservation community that the human relationship with coastal and ocean environments must be evaluated in cultural, social, and economic—as well as ecological—dimensions. The major insights from this booklet include:

- People depend on oceans for food security, recreational opportunities, shoreline protection, climate regulation, and other ecosystem services.
- Marine resources have tremendous economic value that far exceeds current investments in marine governance, and visitors often are willing to pay far more than existing user fees.
- MMAs improve human well-being by diversifying livelihoods, enhancing incomes, and improving environmental awareness. They also pose challenges, including loss of access to fishing grounds, inequitable distribution of benefits, dependence on project assistance, and unmet expectations.
- MMAs are influenced by socioeconomic and governance conditions, including benefits exceeding costs, shared benefits, improved livelihood options, strong community participation, accountable management style, supportive local government,

What are marine managed areas?

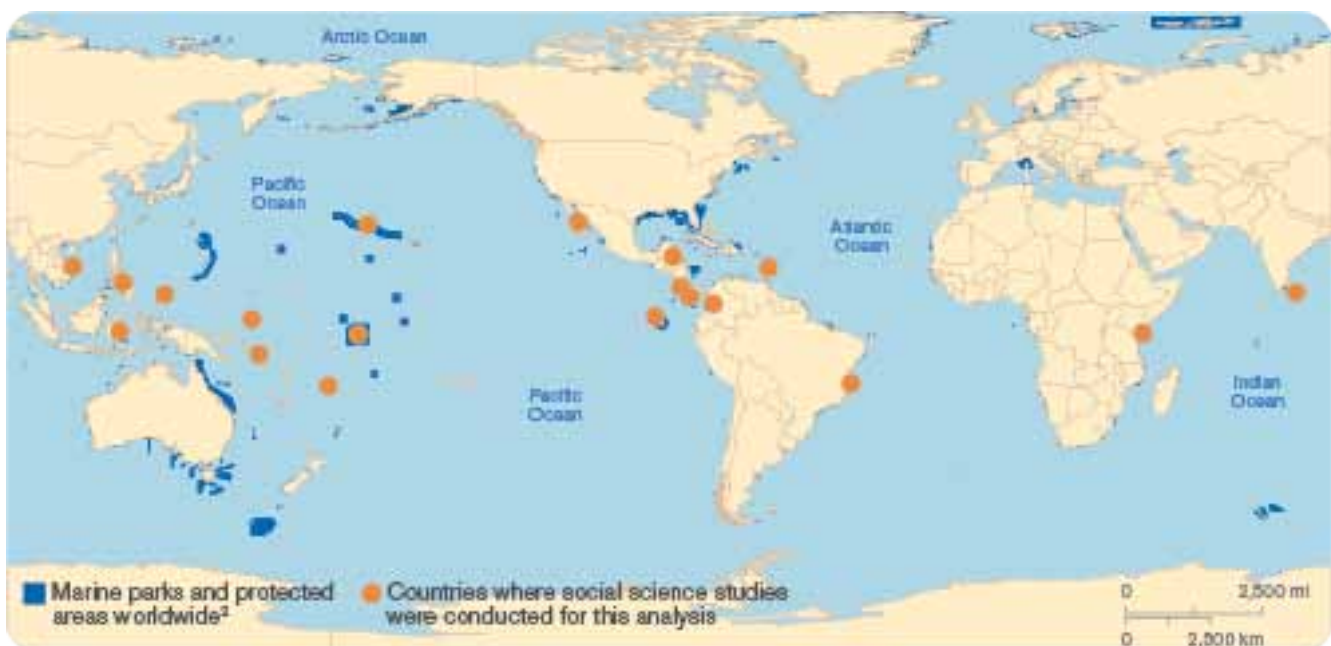
MMAs, as defined for this booklet, are multiuse, ocean zoning schemes that typically encompass several types of subareas, such as no-take areas (e.g., no fishing, mining), buffer zones with particular restrictions (e.g., no oil drilling), or areas dedicated to specific uses (e.g., fishing, diving).

MMAs can take many forms, addressing different issues and objectives. Some MMAs involve areas where multiple uses (e.g., fishing, tourism) are allowed under specific circumstances. Others involve areas where no extractive human uses (e.g., fishing, mining, drilling) at all are allowed. Still others restrict certain areas to one specific use (e.g., local fishing) that is judged to be the most beneficial use of that area to the exclusion of others.

The term 'marine managed areas' often is used interchangeably with 'marine protected areas' (MPAs) as an inclusive way to describing different types of MPAs ranging from those with multiple-use to areas of complete protection. For more information on MMAs, see *Marine Managed Areas: What, Why, and Where* available at www.science2action.org.

enabling legislation, enforced rules, empowerment and capacity building, strong persistent leadership, and involved external agents.

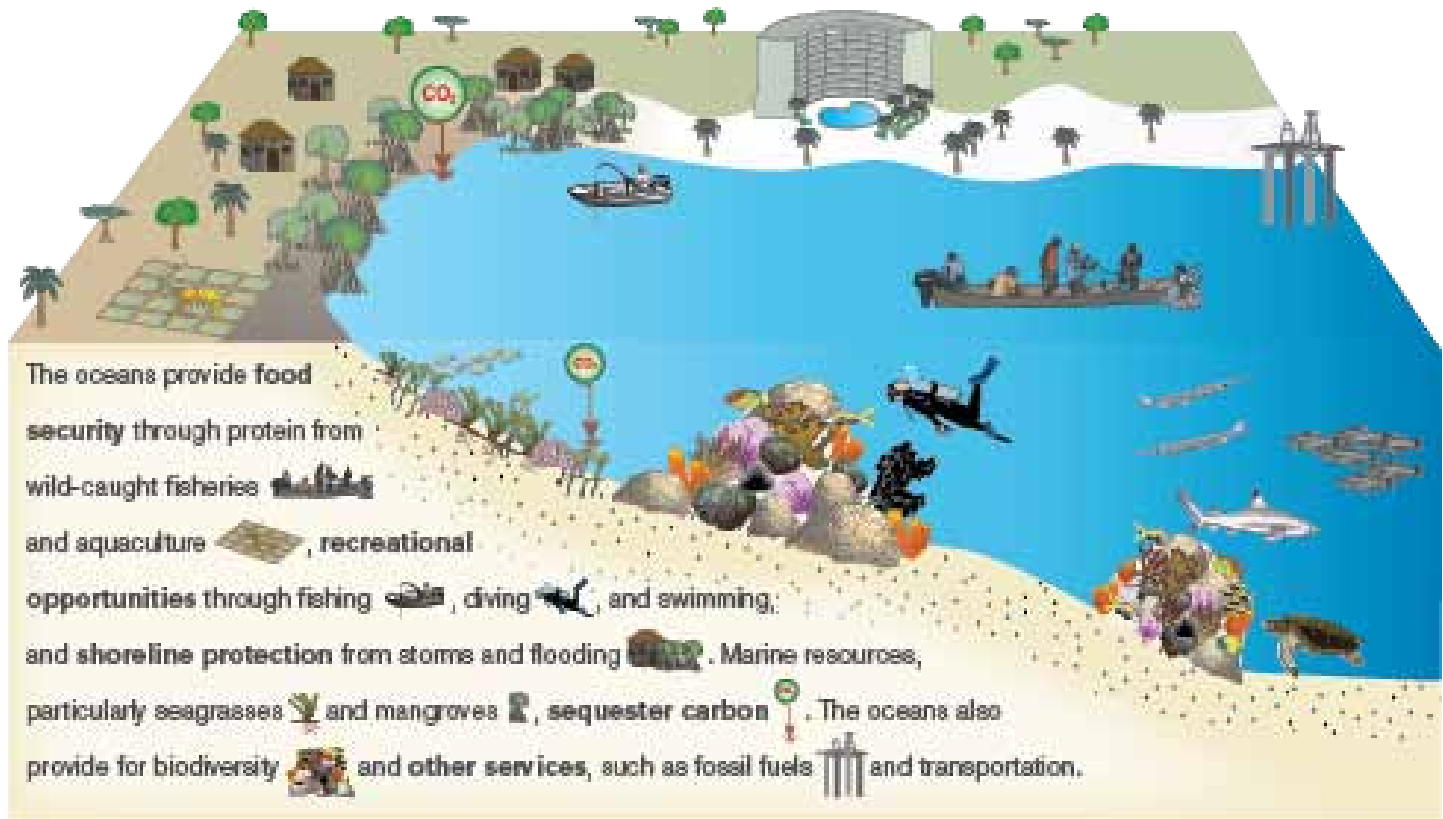
- Effective MMAs require strong enforcement, including both soft measures (i.e., education, partnerships) and hard measures (i.e., detection, interception, prosecution, and sanctions).
- Approaches such as buyouts, conservation agreements, and alternative livelihoods provide positive incentives for altering human behavior.



People depend on oceans

Ecosystem services

The ocean provides a wealth of services that directly benefit human well-being. Over half the world's population lives within 100 miles of a coastline, and 20 of the 30 largest cities in the world are coastal. There is increasing access to remote areas, and there are important connections between human well-being and the marine environment. The most widely recognized marine ecosystem services are discussed.



Conceptual diagram illustrating the ecosystem services provided by oceans and the ways in which humans depend on oceans.

Food security

Oceans are the main protein source for one in four people worldwide, which means that over 1 billion people depend on fisheries for protein each year.^{3,4} Fisheries also provide livelihoods to billions of people and generate tremendous economic benefits calculated at a total catch value of US\$80-85 billion per year.⁵ Coral reef fisheries alone have a net benefit per year of US\$5.7 billion,⁶ and mangroves have an annual seafood market value of US\$7,500-\$167,500 per square kilometer.⁷ In general, fisheries are most important to impoverished areas and areas with few alternative livelihoods, such as Southeast Asia, where sustainable fisheries have an estimated annual net benefit of US\$2.4 billion⁸ and employ an average of 55% of coastal residents.⁹ There is even greater dependency in isolated places, such as the Lakshwadeep Islands, where fish supplies 90% of the protein for residents, and Quirimbas, Mozambique, where over 80% of households depend on fishing.⁹



Harvesting conch to sell in local markets in Barbuda.

Recreational opportunities

Recreational opportunities—swimming, diving, snorkeling, fishing, and simply lying on the beach—are enjoyed by billions of people each year. Coral reef-based tourism alone is worth US\$9.6 billion in global annual net benefits,⁶ whereas the average global value of coral reef-based recreation is US\$184 per visit.¹⁰ Marine tourism provides livelihoods and spurs economic development, particularly in emerging economies. In Central America, 60%-70% of coastal residents in 17 communities depend on tourism for their livelihoods.⁹ In the Caribbean, reef diving produces US\$2.1 billion in annual revenues,¹¹ and tourism accounts for 43% of the regional gross domestic product.⁹ Tourism is increasingly providing a means of diversifying previously fisheries-dependent coastal economies. In the western Indian Ocean, tourism often provides a safety net for coastal residents, who are finding employment as boat operators.



Beachgoers in Hawaii.

Shoreline protection

Marine ecosystems, such as coastal wetlands and coral reefs, provide strong buffers for local communities in the event of storms and hurricanes. With half the world's population within 100 miles of the coast and migration continuing, the buffering role of marine resources against storms, erosion, and sea level rise is particularly important. The shoreline protection provided by coral reefs alone is valued at US\$9 billion total net annual benefit,⁶ and coastal wetlands in the United States provide US\$23.2 billion per year in storm protection services.¹² In a post-tsunami study in eastern India, the villages protected by mangroves were found to incur less loss than villages protected by an embankment.¹³



Coastal flooding in Bangladesh.

Climate regulation

The world's oceans play a critical role in regulating global climate change.¹⁴ Oceans are the largest long-term sink for carbon on earth—55% of all biological carbon fixed is captured by marine organisms.¹⁵ Although the ocean's vegetated habitats (mangroves, seagrasses, and salt marshes) only have 0.05% of the total biomass of terrestrial plants, they store a comparable amount of carbon globally per year—so are amongst the most efficient carbon sinks on the planet.¹⁵



Coral bleaching in Belize.

Other services

Additional services provided by marine resources include providing medical and engineering properties; recycling nitrogen and water; regulating run-off of waste and sediment; providing (wave, fossil fuel) energy; providing global shipping transportation; maintaining life cycles of species; providing aesthetic values; providing areas of spiritual, traditional, historical, and archeological significance; maintaining genetic diversity; and housing the greatest diversity and abundance of living organisms on Earth.



Diverse coral reefs in Fiji.

Sustainable human cultures need sustainable environments

Oceans define people

Human cultures and societies are defined by the biological and physical environments in which they live. People who live near or on the ocean or use its environments and resources for sustenance or recreation develop cultures, economies, and lifestyles that reflect proximity to and dependence on those environments and resources.¹⁶



Blessing of the fleet in Grenada.



Taking the patron saint, Virgen del Carmen, out to sea for the day off the Panamanian coast.



Catching fish in Abrolhos region, Bahia, Brazil.



Kayaking has become a popular pastime among tourists and residents in Belize.

Religion and spirituality

Religion and spirituality are two areas where people's relationship with the ocean is exhibited most strongly. With the naming of saints as protectors of seafarers and gods of the sea, human perception of, relationships with, and dependence on the oceans clearly are evident. The risk and uncertainty of depending on ocean voyaging and ocean resources, for example, is evident in the "blessings of the fleet" that regularly take place in fishing communities.

Songs and festivals

Popular, traditional, and religious themes involving the coast and the sea are evident in sea chanteys, visual art depicting the coast and sea, and both daily activities and seasonal festivals.¹⁷ In the words of one song from the Gulf of Chiriqui, Panama, where Coiba National Park is located:

Ajé Capitán

Capitán, la lancha es mía.
Los remos serán de usted.
Si nos vamos a la una o salimos a las tres.
Si salimos de Remedios y llegamos a
Mensabé.
Capitán, si usted me lleva con usted me
embarcaré.
Coro: ¿Ajé capitán, qué dice usted?

Hey Captain

Captain, the boat is mine.
The paddles are yours.
If we go out at one o'clock or at three
o'clock.
If we leave Remedios and we arrive at
Mensabe.
Captain, if you take me with you, I will
embark.
Chorus: Hey Captain, what do you say?

Sustenance

Wealth is measured not only by money, but also by the ability to derive one's own subsistence; good physical and mental health in safe, nonpolluted environments; food security; and other items that go into the total well-being of people and their communities. For example, conch serves as food, functional objects (e.g., musical horns), and ornaments; eels and octopus supply food and ink for clothing and art; and the salt of evaporated seawater is used for cooking. The ocean also provides the highways for waterborne trade and commerce.

Leisure and recreation

Historically, cultures all around the world, whether they live on the ocean or not, have enjoyed the leisure and recreational aspects of coastal and marine environments. Whether it is simply lying on the sand watching the waves, surfing those same waves, diving below the surface with a scuba tank, or casting a fishing line in the water, the ocean provides people with a variety of leisure and recreational activities.

People define oceans

In turn, the human cultures, economies, and lifestyles that are defined by proximity to or dependence on coasts and oceans lead to often-significant alterations to those environments and resources. The destruction of a mangrove forest for a house or hotel; fishing for food, commerce, or recreation; the construction of a bulkhead or jetty to protect human-built structures; pollution from ships, boats, and coastal communities; and the acidification of the ocean through human carbon dioxide emissions are all examples of how human use of coasts and oceans define the configuration and characteristics of those environments and resources. Human use and governance systems, such as marine managed areas, should be constructed so as to provide for the sustainable use of these environments and resources, and thus for sustainable human cultures, economies, and communities.¹⁶

Development controversies

Coiba National Park, Panama

Communities adjacent to Coiba National Park are grappling with difficult decisions regarding development. Some families are selling their properties to large developers and leaving the region, whereas others are working with local nongovernmental organizations to develop their own tourism businesses. The result is a mix of large- and small-scale developments with varying dependencies and impacts on marine resources—a challenge faced by many coastal communities worldwide.



Subsistence fishing

Locally managed marine areas, Fiji

In Fiji, a customary marine tenure system built on local autonomy and self-reliance controls the use of local marine space and resources. These customary fishing grounds (*qoliqolis*) support subsistence fishers as well as some commercial interests. Not only do these livelihoods support traditional fishing practices, but they also support a value system where wealth is related to such nonquantifiable benefits as being able to provide sufficient food for guests at functions within the community.



Buy-in from fishers

Laughing Bird Caye National Park, Belize

Because the area was well suited for both fishing and tourism, it was primarily tour operators and guides who pushed for the protection of Laughing Bird Caye, leading to the declaration of the Laughing Bird Caye National Park in 1996. Fishers worried that they would lose access to fishing grounds. However, they became increasingly positive about the park once they realized fish stocks were increasing and resulting in a “spillover effect” that was beneficial to them.



Community empowerment

Corumbau Marine Extractive Reserve, Brazil

Six villages worked together to establish the Corumbau Marine Extractive Reserve. One of the major concerns was that all community members benefit equally from tourism activities. Community discussions determined that the boat ride activity should be community based and equitable. As a result, there is one common ticketing office, and the community boats take turns serving the tourists.

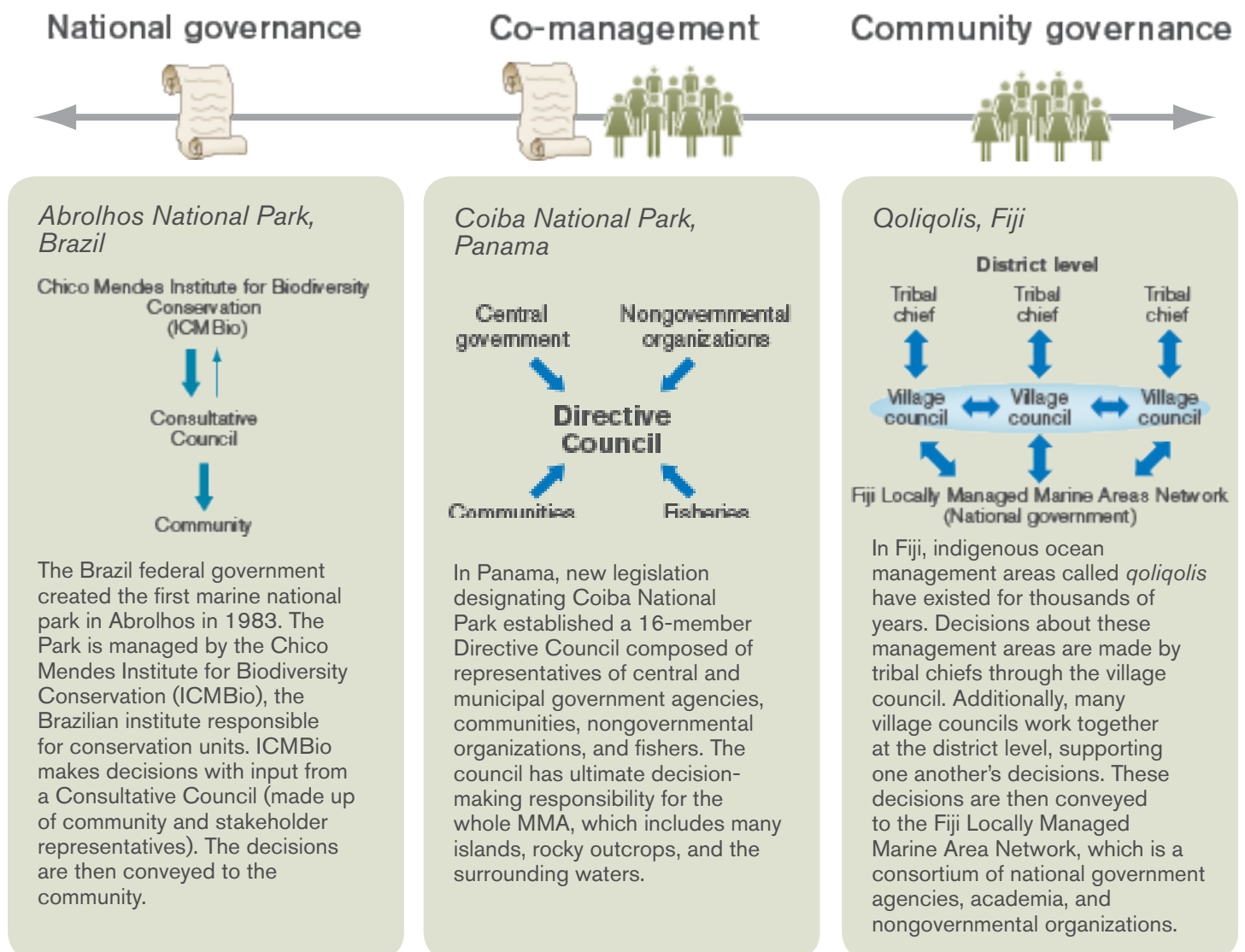


Governance and enforcement are critical to managing oceans

Governance spectrum

Governance systems—those arrangements by which communities of people at different scales make common rules of behavior—occur in many different forms across nations and cultures. There is also a significant difference between governance structures on land and in the sea. On land, most property and many resources are subject to private ownership, or private property. In the sea, it is generally true that the water, seabed, and resources are common pool, or common property. That is, marine environments and resources are held in trust by governments and managed for the benefit of all people.

Within the common pool of marine environments and resources are many different governance arrangements, such as national governance, co-management, and community governance.¹⁸ These arrangements also can extend across national boundaries for transboundary international environments and resources. All, however, feature different scales of human communities with specific cultural values pertaining to the use of marine environments. For example, a particular area may be valued by a society for spiritual or aesthetic reasons, and significant use or alteration may not be desirable. Another area may be valued for a particular extractive resource, such as fish, and significant use may be desirable. The key is that the values of the culture and society are reflected in the MMA governance.¹⁹



Enforcement

The ability and capacity to enforce is critical to any MMA. Legislation, regulations, and management plans are weak unless enforced. Typically, enforcement focuses on external threats; however, there are numerous internal issues that affect enforcement efforts and, therefore, also must be addressed.²⁰

External threats



- Overfishing
- Destructive fishing
- Land-based sources of pollution and eutrophication
- Sedimentation from upland land clearing
- Physical destruction from coral mining or mangrove clearing
- Introduction of invasive species

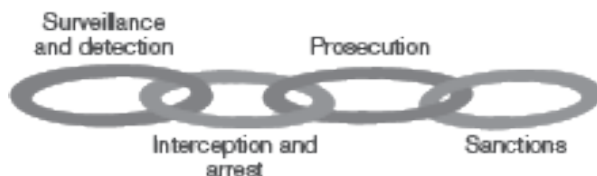
Internal issues



- Underfunded budgets
- Inadequate regulations
- Overlapping and uncoordinated responsibilities
- Inadequate resources
- Insufficiently trained park wardens

Approaches to enforcement

Enforcement generally is recognized as consisting of four core components:



Together, these four components compose the enforcement chain, which is only as strong as its

weakest link. For example, in the Eastern Tropical Pacific Seascape, the prosecution link was found to be the weakest link in the region, indicating the need to focus on this, whereas surveillance and detection is the strongest link, indicating little additional effort needed for this.²⁰ If users recognize the weak links, the entire chain is devalued. In addition to these links, the enforcement chain depends on a sound regulatory framework and education efforts to raise awareness of these regulations and the consequences of violations.

Using lessons learned from Colombia, Ecuador, Panama, and Costa Rica, the four links of the enforcement chain were evaluated to determine the strengths and weaknesses, identify the factors affecting these conditions, and provide recommendations.²⁰

Enforcement chain	Factors affecting enforcement	Recommendations
Surveillance and detection	<ul style="list-style-type: none"> ▪ Strong nongovernmental organization commitment ▪ Appropriate boats available at least 80% of time ▪ Well-coordinated operations among MMA, environmental police, and central government environmental agency 	<ul style="list-style-type: none"> ▪ Improve technology (vessel monitoring system, automated information system) ▪ Provide adequate boats ▪ Extend geographical surveillance ▪ Extend regional cooperation
Interception and arrest	<ul style="list-style-type: none"> ▪ Proper boarding procedures ▪ Proper crime scene investigation procedures ▪ Adequate management of evidence ▪ Correct and timely presentation of evidence 	<ul style="list-style-type: none"> ▪ Establish quarantine procedures ▪ Create functions and procedures manuals ▪ Conduct training for MMA wardens
Prosecution	<ul style="list-style-type: none"> ▪ Efficient processes ▪ Resolution of cases ▪ Clear communication ▪ Clear legal framework ▪ Political independence 	<ul style="list-style-type: none"> ▪ Grant MMA directors the authority to sanction infractions and act as first-instance judges
Sanctions	<ul style="list-style-type: none"> ▪ Strong implementation of international regulations ▪ Timely processes 	<ul style="list-style-type: none"> ▪ Embrace the UN Convention on the Law of the Sea, UNESCO, IMO regulations ▪ Solicit international support from multilateral institutions ▪ Increase economic sanctions ▪ Implement procedures for repeat offenders ▪ Apply collateral sanctions (e.g., boat detainment, gear confiscation, suspension of licenses)

MMAs improve human well-being

Traditionally, MMAs have been established to achieve ecological goals (e.g., protect endangered species, increase fish populations). Today, social, economic, and cultural objectives are being incorporated into MMA planning. Therefore, an understanding of the resulting socioeconomic and governance effects is vital for maximizing benefits and minimizing costs. Scientific research supported by expert opinion demonstrates both the benefits and the challenges as perceived by stakeholders.^{18,21,22} Often, it is the MMA process, not the MMA itself, that leads to benefits or challenges. For example, a group of stakeholders working together to establish an MMA may be empowered to work together to achieve other objectives.

Benefits

More diversified livelihoods—MMAs often attract new business opportunities, such as ecotourism. The management authority itself may specifically promote alternative livelihood programs to replace unsustainable practices.^{18,23}

Improved household income—Sustainable user practices and new livelihood opportunities often lead to greater income potential.^{21,23}

Greater food security—If catch increases in the area due to more sustainable fishing practices, then seafood may be more abundant in the market. More broadly, if livelihoods improve, people may be better able to feed their families.²²

Improved human health—The community standard of living, as evidenced by human health, often improves by providing new livelihood opportunities, greater political attention, and subsequently greater resources and programs to the area.¹⁸

Greater community participation—If community members become engaged in MMA decision making, then they also may become engaged in broader community decision making related to other issues.

Enhanced community empowerment—The process of bringing together various stakeholders to manage the MMA may empower them to work toward achieving other common goals. The training that accompanies many MMAs also builds local skills, particularly for women and marginalized groups.²³

Reduced user conflicts—Often, MMAs are established to resolve user conflicts (e.g., between fishing and tourism), which may be accomplished through zoning schemes or through better understanding and respect toward varying resource needs.^{22,23}

Improved compliance—By focusing management efforts in a defined area and by actively engaging stakeholders in the MMA process, compliance is likely to be greater.²²

Greater recognition of traditional fishing and other user rights—If stakeholders, such as local fishers, play an active role in MMA design, then their rights may be afforded special recognition.²³

Greater environmental awareness—MMAs often include an environmental outreach program, resulting in improved public awareness of the biodiversity and value of marine ecosystems as well as potential threats.^{18,22}

Enhanced social capital—Discussions of rules and MMA management strengthen social ties and enhance connections between individuals and institutions.

Greater social resilience—Greater social capital and more diverse livelihood opportunities help to ensure that communities are able to endure economic turmoil.

Protected large species lead to increased tourism

Galapagos Marine Reserve, Ecuador

The fishing ban on top predators in the Reserve has resulted in increased megafauna, which has provided greater tourist attractions. As the tourism industry has grown, so have livelihood opportunities and incomes.

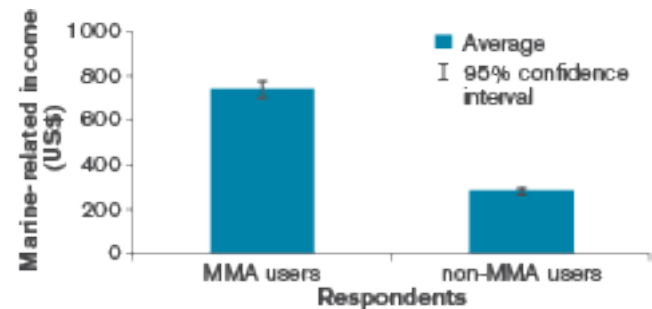


A closer look at MMA benefits

In-depth analysis of the benefits and challenges of MMAs in Belize, Ecuador, Fiji, and Panama identified the following improvements.¹⁸

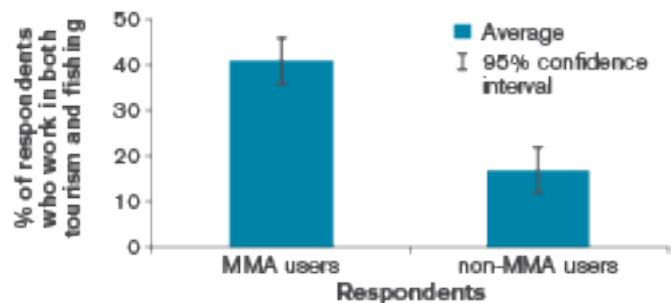
Greater income

Community members whose livelihood (e.g., fishing, tourism) is directly tied to the MMA (MMA users) have a higher average income than community members whose livelihood is marine based but not tied to the MMA (non-MMA users).



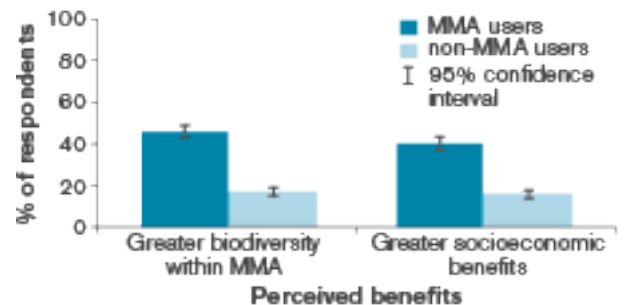
More diversified livelihoods

Community members whose livelihood is directly tied to the MMA (MMA users) are much more likely to be engaged in both tourism and fishing than community members whose livelihood is marine based but not tied to the MMA (non-MMA users).



Improved environmental awareness

Community members whose livelihood is directly tied to the MMA (MMA users) have a much greater appreciation for the biodiversity and socioeconomic benefits of the MMA compared with community members whose livelihood is marine based but not tied to the MMA (non-MMA users).



Challenges

Loss of access to fishing grounds—Although MMAs vary in their management strategies, many establish new fishing restrictions or designate no-fishing zones in ecologically critical areas (e.g., spawning aggregations, nursery grounds). From the perspective of the long-term fishery, this loss of access is compensated for by the long-term benefits of a sustainable fishery. In the short term, measures need to be considered that compensate fishers for lost access.²³

Inequitable benefits—MMAs can provide tremendous economic opportunities. However, there is a risk that, unless well-planned, the benefactors will be those who have the capital and business skills to take advantage of these new opportunities, which are often not local people but large, established businesses from the capital city and abroad. Managers and stakeholders need to address this challenge from the beginning through measures such as business training, credit programs, and controls on ownership.²³

Dependence on project assistance—Often, MMA establishment and management leads to an influx of technical capacity and funding from outside the immediate area, which can be from government, nongovernmental organizations, or the private sector. Although this support may be critical to initiating these efforts, self-financing needs to be long term and sustainable and identified early in the MMA process.²³

Unmet expectations—With any new initiative, there likely will be varying expectations among stakeholders, all of which cannot be met. Most common among MMAs is the expectation that the MMA will provide immediate benefits, whereas the reality is that both ecological and socioeconomic changes can take years. Consequently, it is critical that managers clarify what is realistic, over what time scales, and what measures are needed to achieve these goals.²³

MMAs are influenced by socioeconomic and governance conditions

By identifying key socioeconomic and governance conditions that are related to desirable MMA outcomes, managers can focus resources to maximize effectiveness of a MMA. Analysis of MMAs worldwide identified several key conditions that are correlated to improved outcomes, including improved livelihoods, food security, resource conflict resolution, biodiversity, and ecological health.²²

Benefits exceed costs

If stakeholders believe that the benefits of MMAs (e.g., greater income, new livelihood options) are greater than the costs, then they are more likely to support and comply with regulations.

Shared benefits

If stakeholders believe that benefits and costs are shared equitably across sectors (i.e., tourism, fisheries), then they are more likely to support and comply with regulations.

Livelihood options improved

Providing new livelihood opportunities helps to offset any perceived socioeconomic costs of management regulations, such as limited access to fishing grounds.

Strong community participation

By participating in MMA design and implementation, community members and organizations gain a sense of ownership and are, consequently, more likely to support and comply with regulations.

Accountable management style

A management process in which business is conducted in an open and transparent manner with all partners held equally accountable for management decisions and processes is important for stakeholders to believe that the MMA is effective.

Supportive local government

Local government is critical for raising community awareness, engaging community members in MMA decisions, and enforcing management regulations.



Local nongovernmental organizations, with external support, developed the fly fishing industry in southern Belize as an alternative livelihood for fishers.



Discussions with local people in West Papua about issues such as patrolling beaches for sea turtle nests helped to ensure active community engagement.

Enabling legislation

Enabling legislation provides the foundation upon which all management decisions are made.

Rules enforced

Enforcement enhances compliance by demonstrating the costs of violating regulations and in doing so ensures that a MMA is truly functional rather than just a “paper park.”

Empowerment and capacity building

By building local capacity to manage resources through training and mentoring, stakeholders gain a greater sense of ownership and are more likely to support and comply with management regulations.

Strong, persistent leadership

Strong, persistent leadership demonstrates commitment and continuity, which can help to build local buy-in to what is perceived as a sustainable initiative.

External agents involved

The support provided by external institutions and individuals, such as technical assistance, facilitation, and law enforcement, augments local capacity.



Regular, transparent community discussions among community members, scientists, and decision-makers has helped to ensure community support for and compliance with management regulations in Abrolhos, Brazil.



Extensive field experience, mentoring, and training by senior scientists resulted in a young, highly qualified ecological monitoring team throughout Belize.

Maintained and enhanced livelihoods

Misali Island, Zanzibar

Destructive fishing practices were banned in the Misali Island Conservation Area, which led to a greater range of livelihoods available to the community through tourism activities and other alternative livelihoods. Critical to this success was the involvement of an external agent, Care International. Also critical to success was the hiring of full-time rangers to enforce the ban.²²



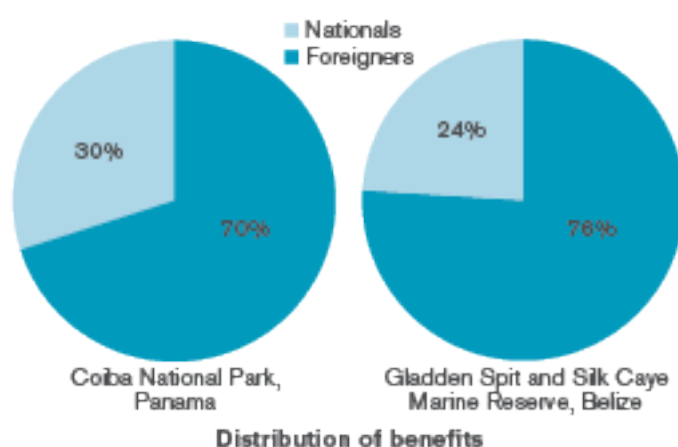
MMAs secure economic values of oceans

Marine and associated coastal ecosystems are among the most productive on earth, providing goods and services that directly and indirectly benefit humans. People depend on fisheries, tourism, and other activities for their livelihoods. Because coral reefs provide a variety of benefits to people, their protection can be an important public investment.

Economic valuations of Coiba National Park, Panama, and Gladden Spit and Silk Caye Marine Reserve, Belize, provide insight into not only economic values, but also who benefits from conservation efforts and people's willingness to pay to protect these resources.^{24,25} This analysis demonstrates the importance of continued support and funding for MMAs.

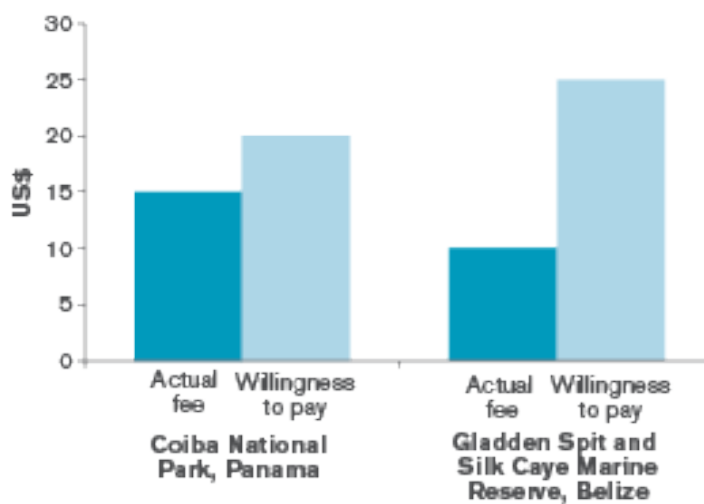
Foreigners and nationals benefit

The economic valuations of Coiba National Park, Panama, and Gladden Spit and Silk Caye Marine Reserve, Belize, found that both nationals and foreigners benefited economically. Foreigners reap as much as US\$3 for every dollar of benefits received by nationals. In Coiba National Park, the national beneficiaries are tour operators and fishers, whereas the foreign beneficiaries are tour operators and tourists. In Gladden Spit and Silk Caye Marine Reserve, foreigners include both international tourists and international hotel owners, whereas nationals are residents in the nearby village and fishers from northern Belize.^{24,25}



Willingness to pay

The economic valuations of Coiba National Park and Gladden Spit and Silk Caye Marine Reserve found that visitors are willing to pay significantly more than the current entry fees charged at these parks. Coiba National Park tourists are willing to pay US\$20, although the current fee is only US\$15. Gladden Spit and Silk Caye Marine Reserve visitors are willing to pay US\$25, although the current fee is only US\$10. Raising the fees would ensure more adequate funding for the MMAs.^{24,25}



MMA investment effectiveness

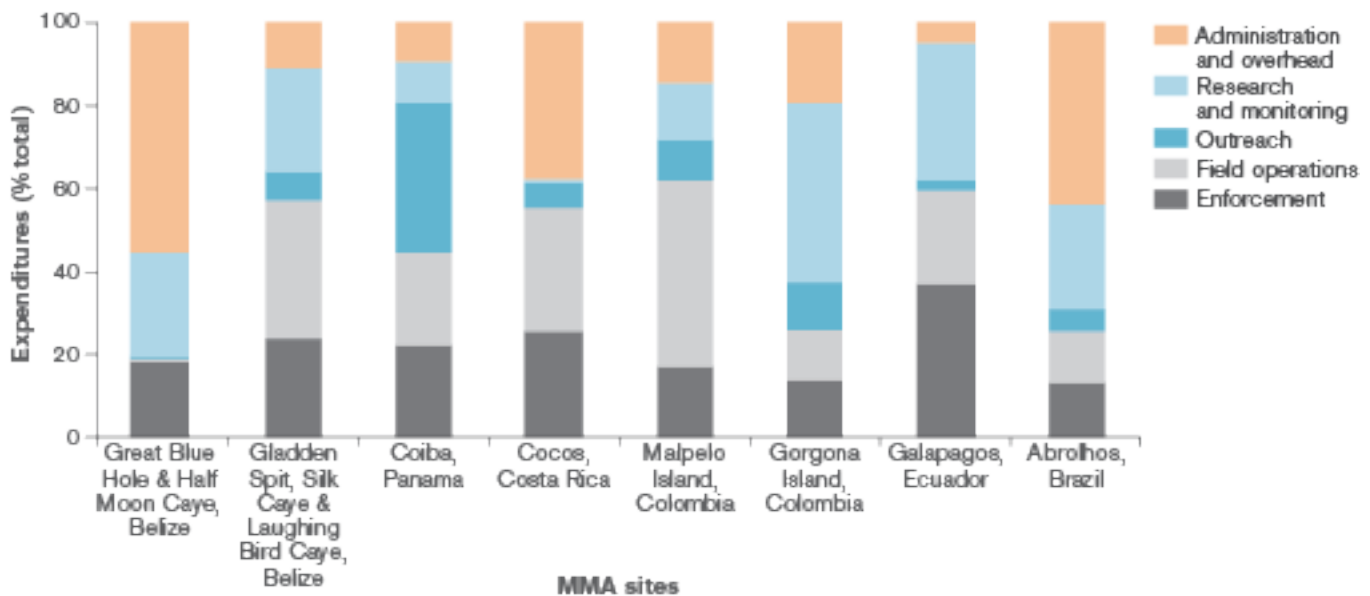
A key issue facing MMA managers is how to allocate limited funding. Based on a global literature review, the following three components of MMA management are needed for maximum MMA effectiveness:

- Building local community capacity through effective outreach,^{26,27}
- Having effective and fair enforcement,²⁸ and
- Conducting research and monitoring that incorporates local ecological knowledge.²⁹

An analysis of eight MMA sites in Central and South America examined patterns of how funding is allocated among budget items, differences among sites, and how these differences relate to characteristics of the MMA. Total expenditures for these sites ranged from US\$88,000 to US\$1,431,300 and covered a variety of uses, with enforcement, research and monitoring, and field operations composing a large proportion of the budget. The analysis produced the following key conclusions.

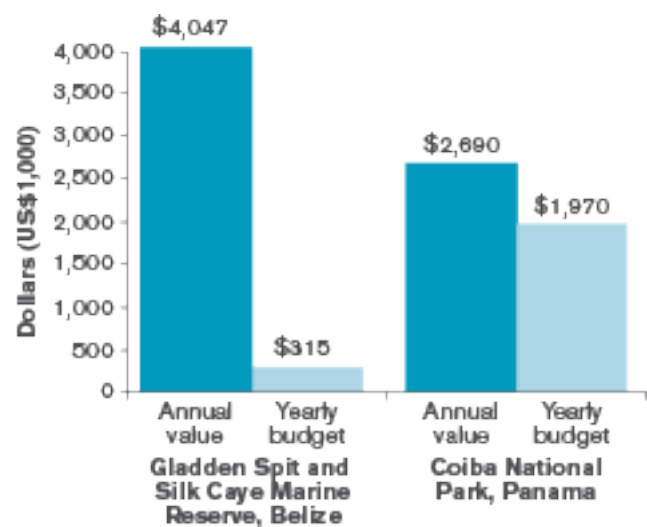
- Enforcement was allocated a significant proportion of expenditures at every site, ranging from 13% to 37%.
- In most cases, outreach was allocated a relatively small proportion of total expenditures.³⁰

A comparison of what should be funded with what is being funded indicates that more funding needs to be put toward outreach while continuing to support enforcement as well as research and monitoring.






Current MMA funding is insufficient

Worldwide, managers and decision-makers are constantly seeking more funding for MMAs. Valuing these protective resources and associated services is one means to demonstrate their importance and, therefore, the need to invest in their protection. A comparison of the economic values of the resources of Coiba National Park, Panama, and Gladden Spit and Silk Caye Marine Reserve, Belize, against their current budgets indicates a substantial difference. Gladden Spit and Silk Caye Marine Reserve's annual value is 10 times the yearly MMA budget, and Coiba National Park's annual value is 36% greater than the MMA budget. This analysis suggests a greater need for investment in managing these resources to be more in line with their value.^{24,25}



Buyouts, conservation agreements, and alternative livelihoods provide economic incentives

Economic incentives are tools used by conservation investors (e.g., nongovernment organizations, government, private sector) to engage resource users (e.g., local residents, fishers, developers) and to motivate behavioral change to minimize unsustainable practices, such as destructive fishing or widespread mangrove clearing.³¹

TYPE OF INCENTIVE			
DEFINITION			
Reward	Purchase of resource rights or equipment.	Direct compensation for behavior change.	Income or subsistence from new livelihoods.
Behavior change	Reduce harvest levels.	Halt ecosystem-damaging activity.	Halt reliance on unsustainable resource use.
MECHANISM	Reward compensation for reduced harvest capacity. Enforcement maintains the change.	Reward provided only if behavior changes.	Reward follows when alternative livelihood becomes economically viable.
REWARD	Usually cash.	Social benefits (e.g., health, education, transportation). Cash.	Income or consumption of goods from new livelihoods.
MAINTAINING CHANGE	Government agencies must continue to provide monitoring and enforcement.	Conservation investors must ensure continued monitoring of compliance and delivery of benefits.	Resource users must continue to engage in new activities and avoid unsustainable resource use.
COST STRUCTURE	Large, initial cost. Ongoing enforcement cost.	Ongoing cost of benefits and monitoring.	Cost of training, technical assistance, and initial funding for new livelihoods. New activities designed to become self-sustaining.
ESSENTIAL FOR SUCCESS	Well-defined access rights over the resource. Effective enforcement.	Long-term commitment from conservation investor.	Becomes and remains more profitable than unsustainable resource use.
EXAMPLE PROJECT	Purchase and retire fishing licenses to reduce total harvest in an area.	Cover annual teacher salaries as long as no-take zone is observed.	Provide skills training and start-up funds for ecotourism venture.



Twenty-seven cases were selected to examine the role of economic incentives in driving behavioral change. Three of the studies are highlighted below.

Type of incentive: Buyout

Morro Bay, California, USA



Challenge:

Bottom-trawling, causing habitat destruction.



Incentive:

The Nature Conservancy purchased six federal trawling permits and four trawling vessels.

Conservation action:

A network of no-trawl zones in approximately 1.5 million hectares of ocean.

The future:

Plan to lease back the permits to fishers, restricting them to sustainable harvesting methods.

Type of incentive: Conservation agreement

Laguna San Ignacio, Mexico



Challenge:

Coastal development threatening gray whale habitat.



Incentive:

International Community Foundation provides US\$25,000 for small-scale development each year the community complies with the contract terms.

Conservation action:

Protection of 120,000 acres of gray whale habitat.

The future:

The contract between Ejido Luis Echeverria and nongovernment organizations is permanent, including monitoring by a third party, Pronatura.

Type of incentive: Alternative livelihood

Kubulau, Fiji



Challenge:

Overfishing and unsustainable methods, resulting in fishery decline.



Incentive:

Kubulau communities collect dive tag fees from tourism operators, which fund management activities and community benefits.

Conservation action:

With support from the Wildlife Conservation Society and others, communities maintain a network of 13 MMAs to protect dive sites.

The future:

The Kubulau communities intend to become more directly involved in tourism enterprises.

Recommendations

The following recommendations stem from the social science analyses highlighted in this publication and from the natural science analyses highlighted in *Living with the Sea* (both available at www.science2action.org).

Government agencies

- **Regulate** with appropriate penalties to enable managers to effectively police their MMAs.
- **Enforce** MMAs by surveillance and detection, interception and arrest, prosecution, and sanctions.
- **Invest** in MMAs by providing funding, personnel, and infrastructure support.
- **Plan** for sustainable regional development while recognizing global issues such as climate change.
- **Integrate** ocean management with land management.
- **Coordinate** scientific discovery and citizen scientist efforts to support MMAs.

Local community

- **Participate** in the design and establishment of MMAs so that stakeholders are vested in the success of the MMA.
- **Learn** about and **adapt** to changing conditions, and use MMAs as social learning experiments.
- **Celebrate** ocean resources through cultural events, and engage broader groups of people in MMAs.
- **Engage** in alternative livelihoods to sustain marine resources as well as engage in lifelong learning activities afforded through MMAs.
- **Respect** the limits of the ocean and the patchwork of MMAs to maintain diversity of habitats.
- **Wait** long enough for MMAs to have desired effects; impatience with natural ecosystems often is not rewarded.

Marine scientists

- **Monitor** the effectiveness of MMAs in terms of both natural resources and management practices, such as economic incentives.
- **Develop** targeted research to help to decide among trade-offs, and capture the links between natural and cultural knowledge.
- **Disseminate** scientific knowledge to MMA managers and stakeholders for effective management and success of MMAs.
- **Establish** monitoring and research relevant to MMA issues, and draw on local community knowledge.
- **Investigate** the relationship between spatial size and arrangement of MMAs and their effectiveness for fisheries and for other ecosystem features.
- **Create** new scientific tools for professional scientists as well as citizen scientists to better monitor and interpret MMA effectiveness.

Marine managers

- **Seek** economic support for MMAs by matching fees to the willingness to pay (value) of the MMA and by engaging in fundraising activities.
- **Educate** visitors and stakeholders on how people depend on oceans (ecosystem services), and promote awareness of sustainable resource use for long-term benefits.
- **Maintain** compliance of the local community for MMAs using incentives and enforcement.
- **Manage** MMAs in an integrated fashion, encompassing the watershed and adjacent marine ecosystem beyond MMA boundaries.
- **Connect** MMA management to local community initiatives.
- **Facilitate** communication between MMA decision-makers and stakeholders to achieve climate adaptation, biodiversity maintenance, and habitat protection.

Private businesses

- **Allocate** a portion of profits to the establishment and operation of MMAs to assist in long-term conservation.
- **Educate** staff and visitors about conservation practices, and improve environmental literacy.
- **Promote** sustainable use of resources and good conservation practices.
- **Develop** experiences in which a healthy ocean is the feature that attracts sustainable development.
- **Balance** the seemingly contradictory demands of protecting natural resources to be able to reliably obtain these same resources.
- **Focus** on biodiversity and locally unique (endemic) species or habitats to foster ecotourism.

Nongovernmental organizations

- **Foster** long-term partnerships among natural resource agencies, conservation managers, and communities.
- **Inform** policy and influence decision-makers through environmental and conservation education, interpretation, and media outreach programs.
- **Develop** sustainable financing mechanisms, such as payments for marine ecosystem services, in order to provide ongoing economic incentives.
- **Build** capacity in the local community to manage MMAs through training programs and investments in conservation support.
- **Adopt** a systems-wide perspective to managing MMAs within the context of the landscape and seascape.
- **Educate** government officials, scientists, and resource managers about conservation values and economic values of MMAs.

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Our global network puts science into action so that the ocean can provide the multiple benefits needed by people today and tomorrow. Since 2005, we have conducted more than 50 studies in over 70 MMAs in 23 countries, using an integrated approach of natural and social sciences. Based on the scientific results, we develop conservation and management recommendations, and we engage directly with people at local to international scales to implement science-based solutions.

The following **Science-to-Action** publications present global research findings and lessons learned.

Marine Managed Areas: What, Why, and Where defines MMAs and discusses the challenges of implementation.

People and Oceans examines the role of people in MMAs, including the human well-being benefits and challenges of MMAs, and how socioeconomic conditions affect success.

Living with the Sea examines the role of MMAs in restoring and sustaining healthy oceans, particularly the importance of local management efforts.

Science-to-Action provides practical guidance for scientists and decision-makers on using science to inform ocean policy and management.

Economic Incentives for Marine Conservation provides guidance on how to select and implement incentive-based solutions: buyouts, conservation agreements, and alternative livelihoods.

Coral Health Index provides a comprehensive methodology for monitoring the condition of coral reef ecosystems.

Economic Values of Coral Reefs, Seagrasses, and Mangroves: A Global Compilation provides statistics on the economic value of tropical marine resources organized by type of use and by region.

Socioeconomic Conditions Along Tropical Coasts: 2008 demonstrates people's dependence on marine resources for livelihoods, discusses people's perceptions of resource conditions, and highlights governance status worldwide organized by region.

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